Synopsis V1.0
Single Event Transient and Destructive Testing of the Texas Instrument SN74LVCC3245 Octal Bus Transceiver With Adjustable Output Voltage and 3-State Outputs

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I. Introduction

This study was undertaken to determine the single event destructive and transient susceptibility of the SN74LVCC3245 Octal Bus Transceiver. The device was monitored for transient interruptions in the output signal and for destructive events induced by exposing it to a heavy ion beam at the Texas A&M University Cyclotron Single Event Effects Test Facility.

II. Devices Tested

The sample size of the testing was one device. The devices were manufactured by Texas Instruments and were characterized prior to exposure. The devices tested had a Lot Date Code of 0236TI.

III. Test Facility

Facility: Texas A&M University Cyclotron Single Event Effects Test Facility, 15 MeV/amu tune.

Flux: 5.03×10^4 to 2.36×10^5 particles/cm^2/s.

Ion	**LET (MeVcm^2/mg)**
Kr	28.8
Xe	53.1

IV. Test Methods

The SN74LVCC3245 was tested with heavy ions. The basic block diagram showing the test configuration is shown in Figure 1 and the SN74LVCC3245 test circuit is shown in Figure 2. The Test Setup for the SN74LVCC3245 latch up and transient experiment consisted of a multi-channel power supply and a digitizing oscilloscope. Control of all test equipment was performed remotely via General Purpose Interface Bus (GPIB) with a Laptop computer as master. All relevant equipment connections to the SN74LVCC3245 test board were made using scope probes.

The SN74LVCC3245 test board (see Figure 2) consisted of a 74LS136 exclusive OR gate, two 74LS85 four bit comparators and a 74LS244 buffer gate. The test board is capable of testing two devices under test (DUT) remotely and since we only have one DUT we only used DUT socket 1 for the SN74LVCC3245 experiment. Also, DUT socket 1 was used because it can be configured for A to B and B to A data transmission but DUT socket 2 can only go from A to B. The 74LS244 was used to change direction but because of time constraint, DUT socket 2 did not get configured for B to A transmission.

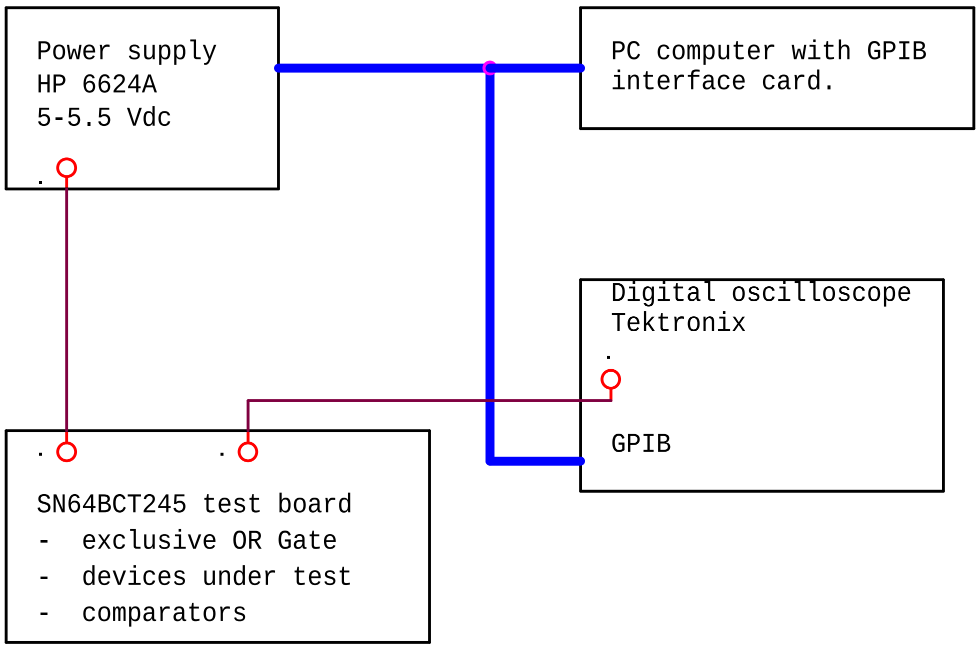

Figure 1. Block diagram for the test configuration for the SN74LVCC3245.

A 74LS136 Exclusive OR Gate (see Figure 2) was used to provide inputs to the SN74LVCC3245 because it allows the test engineer to change the inputs simultaneously using select line 1. This is necessary because the outputs of the SN74LVCC3245 can "hang up" due to the heavy ions, in that situation, the inputs to the SN74LVCC3245 can be change remotely by sending a positive edge pulse to produce a "soft reset" to the device. If the soft reset does not work, then power to the SN74LVCC3245 can be recycled to reset the device. The outputs of the SN74LVCC3245 never "hanged up" during testing so the soft reset circuit was never used.

Two 74LS85 comparators, which compares two four bit binary numbers, were used to monitor the outputs of the SN74LVCC3245. The P0, P1, P2, P3 inputs (see Figure 2) of the comparators were connected to the outputs of the SN74LVCC3245 which is then compared to the Q0, Q1, Q2 and Q3 inputs of the comparators. The P=Q output of the comparators are a logic high when the P and the Q inputs are the same (e.g., no errors) and goes low when the inputs are different (e.g., error). The advantage derived from using a comparator is that two outputs of the SN74LVCC3245 can be monitored at once with different bias settings, which in our case is High and Low.

The P=Q high outputs are monitored via channel 1 and channel two of the digital scope and the output voltage threshold was set at .25 to .3 volts below the monitored output. Throughout the experiment, only one P=Q output is monitored at a time. In the event of a transient, the P=Q high output would go low which will then trigger the set output voltage threshold. The output will then be captured and downloaded into the laptop computer via GPIB. The voltage setting used for the output voltage threshold consisted of two different voltage levels. The reason for this is because the two comparators used have different P=Q high outputs. Comparator 1, which was used for DUT 1, has an output level of 4.7 volts with a set output voltage threshold of 4.5 volts. Comparator 2, which was used for DUT 2, has an output level of 4.5 volts with a set output voltage threshold of 4.2 volts. The delta was set to the lowest value where noise did not trigger events.

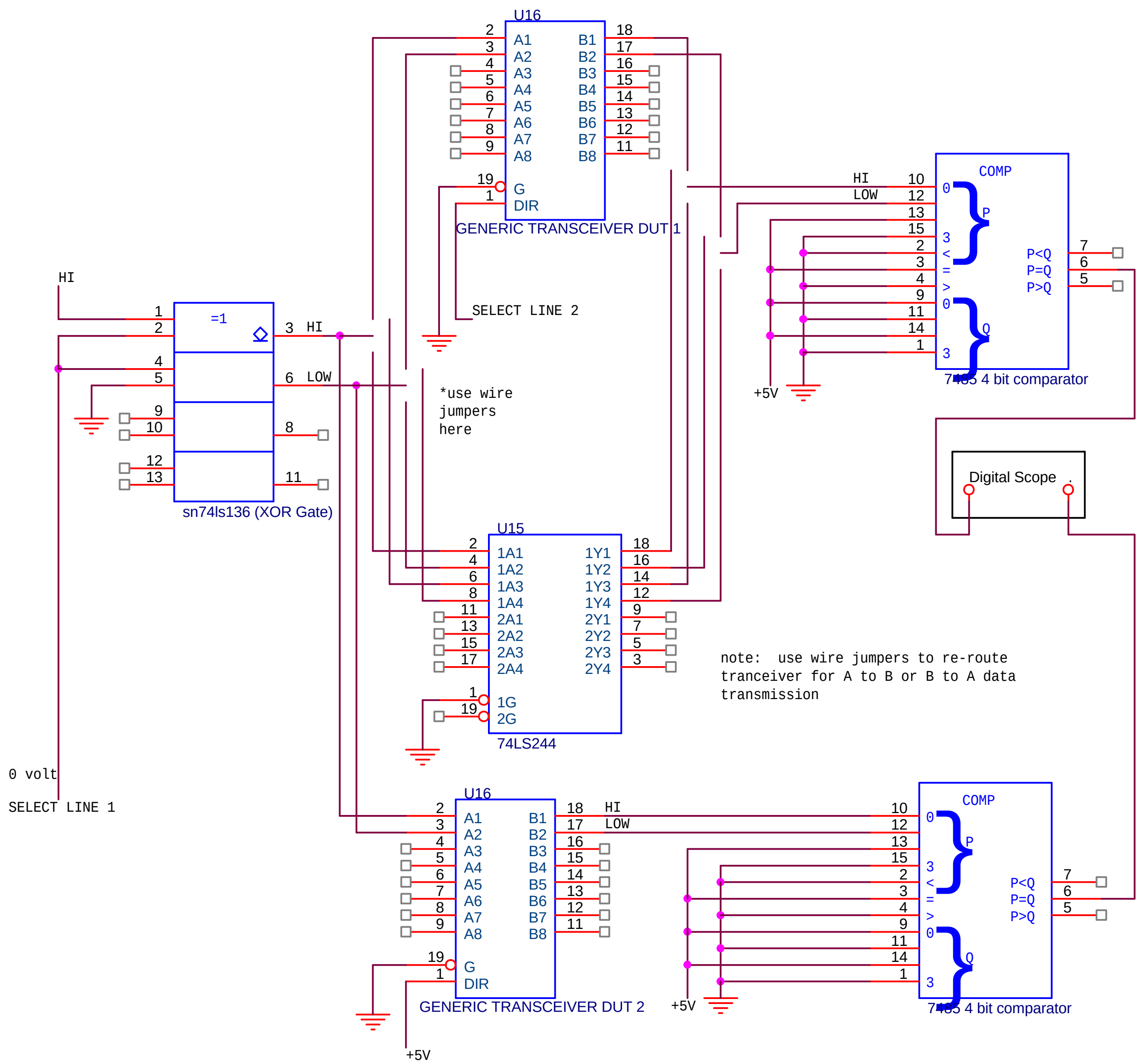

Figure 2. Schematic Diagram for the SN74LVCC3245.

During the experiment, the SN74LVCC3245 was first tested with the voltage supply to the device set at 3.3 volts. After irradiation, the voltage supply was changed to 3.6 volts and the experiment was repeated. Latch up for the device under test was monitored by setting the power supply current limit to 50mA. If at any point the device starts to draw more than 50mA then the power supply will shut down automatically. The set power supply current limit was never exceeded during testing.

V. Results

During testing the SN64BCT245 was irradiated with the Kr beam and Xe beam at normal incidence (yielding an effective LET of approximately 28.8 MeV-cm^2/mg and 53.1 MeV-cm^2/mg). Testing was done for both parts with input voltages set to 3.3 volts and then 3.6 volts (for worst case latchup conditions). Also, testing was done for both parts in the A to B and then B to A direction.

The SN74LVCC3245 Octal Bus Transceiver was tested to measure the latchup cross section under the above conditions. Each part was place in the beam until a latch event occurred or 10^7 ions/cm^2 – the beam fluence was then recorded. During this experiment, no latchup event occurred.

The SN74LVCC3245 was also tested to measure the transient cross section under the above conditions. Each part was place in the beam until transient events occurred or 10^7 ions/cm^2 was reached. If many transients are present then a hundred samples are acquired and then the beam fluence was recorded. During this experiment, no transient events occurred.

VI. Recommendations

In general, devices are categorized based on heavy ion test data into one of the four following categories:

Category 1 – Recommended for usage in all NASA/GSFC spaceflight applications.
Category 2 – Recommended for usage in NASA/GSFC spaceflight applications, but may require mitigation techniques.
Category 3 – Recommended for usage in some NASA/GSFC spaceflight applications, but requires extensive mitigation techniques or hard failure recovery mode.
Category 4 – Not recommended for usage in any NASA/GSFC spaceflight applications.

The SN74LVCC3245 Octal Bus Transceivers are Category 1 devices.